REMARKS

The foregoing amendment amends independent claims 1, 9, 20, 42, 64, 66, and 70 and cancels claim 15. Pending in the application are claims 1-14, 16-45, 47-64 and 66-70, of which claims 1, 9, 20, 22, 29, 42, 64, 66, 67 and 70 are independent. Claims 2-8, 22-41, 49-54, 59, 60 and 67-69 are withdrawn from consideration. The following comments address all stated grounds for rejection and place the presently pending claims, as identified above, in condition for allowance.

Independent claims 1, 9, 20, 22, 29, 42, 64, 66, 67 and 70 are amended for purposes of clarity and to positively recite a first fluid (or a first liquid, or a combination of a first liquid and a second liquid) filling the microchannel, and to specify that none of the first fluid (or first liquid or the combination of a first liquid and a second liquid) enters the fluid interface port. Support for the amendment can be found throughout the application as originally filed, at least, for example in Figures 4A, 8, and described on page 21, lines 20-23. *No new matter is added.*

Amendment and/or cancellation of the claims is not to be construed as an acquiescence to any of the objections/rejections set forth in the instant Office Action, and was done solely to expedite prosecution of the application. Applicant reserves the right to pursue the claims as originally filed, or similar claims, in this or one or more subsequent patent applications.

35 U.S.C. §103 REJECTIONS

In the Office Action, the Examiner rejects claims 1, 9-21, 42-45, 47, 48, 55-58, 61-64, 66 and 70 under 35 U.S.C. §103. Applicants traverse the rejection and submit that the pending claims distinguish patentably over the cited references.

Obviousness Rejections over Heller, McCormick, Amigo, Howitz, Columbus (4,302,313), Bjornson et al., Columbus (4,426,456), Kopf-Sill, Swierkowski, Sundberg and/or Swedberg

Applicants maintain that any combination of the Heller reference, the McCormick reference, the Amigo reference, the Howitz reference, the Columbus '313 reference, the Columbus '456 reference, the Bjornson reference, the Kopf-Sill reference, the Swierkowski reference, the Swedberg reference and/or the Sundberg reference fail to render the claims

obvious. As previously set forth, Applicants assert that the claims distinguish patentably over the cited references, either alone or in any combination. In addition, the claim amendments further distinguish the claims over the cited references, either alone or in any combination. The cited references, alone or in any combination, fail to disclose the subject matter of the claimed invention.

Independent claims 1, 9, 20, 22, 29, 42, 64, 66, 67 and 70 now specify that none of the liquid or fluid filling a microchannel enter into the fluid interface port, a feature not disclosed in the cited references. The recitation of the fluid or liquid filling the microchannel and the absence of the fluid or liquid in the fluid interface port is a positive, structural limitation not disclosed in the cited references. In addition to the structural difference of the fluid, the claimed fluid interface port has several structural differences from ports of the prior art. The claimed fluid interface port is specifically sized, dimensioned, positioned and configured such that a fluid or liquid in a microchannel is prevented from escaping the microchannel interior by capillary forces. As set forth in the specification, the virtual wall created in the fluid interface port "seal[s] liquid inside of the microchannel through a range of pressures in the microchannel." (see Figures 3a and 3b.) This feature is not disclosed in the cited references, which disclose fluids entering into ports.

In addition, Applicants maintain that the cited references, alone or in any combination, do not disclose a device having a fluid interface port with a constant depth that is substantially smaller than the diameter of the fluid interface port, as recited in independent claims 1 and 15. The recited fluid interface ports thus have a *disk* shape, as shown in Figures 2A and 2B, and described on page 17, lines 19-20, to facilitate *direct* access to the channel interior, a feature not taught or suggested in the cited references. The recited shape is not merely a design choice, but rather an inventive feature specifically intended to form a virtual wall that creates minimal dead volume and enables presence of the fluid interface port to have no effect on the fluid flow in the microchannel, in contrast to the changes in fluid flow created in the ports of the cited references.

In addition, the cited references, alone or in any combination, fail to disclose a fluid interface port forming a virtual wall that replaces a *removed* portion of a side wall, or a meniscus surface that is co-planar with a side wall of a channel.

For example, the Heller reference discusses the advantages of an *enlarged* application area A in the injection channels in terms of sample loading accuracy in column 5, lines 32-35, which teaches *away* from a fluid interface port having minimal size and dead volume, which could provide decreased loading accuracy due to the small size. The enlarged application area A would cause liquid in the injection channels to enter the application area when the injection channels are filled. Therefore, the reference requires some of the fluid to enter the fluid interface port, in direct contrast to the claimed invention.

In addition, the cited references, alone or in any combination, fail to disclose a fluid interface port forming a virtual wall that replaces a *removed* portion of a side wall, or a meniscus surface that is co-planar with a side wall of a channel. As previously set forth, the term "co-planar" requires that the meniscus surface substantially align with the edges of the side wall, so that the overall effect of the virtual wall meniscus and the opening in the side wall is substantially zero. Such a feature is not disclosed in or obvious from any of the cited references.

In addition, because the cited references require a larger dead volume in an injection region in order to properly operate, this recitation is not only not disclosed in the cited references, but also not obvious from the teachings of these references.

The Amigo and McCormick references also fail to disclose a microchannel having fluid sealed therein by a meniscus of a fluid interface port, which prevents fluid filling the microchannel from entering the fluid interface port, as required by the claimed invention.

Regarding the rejection in view of the Howitz reference, Applicants submit that the Howitz reference teaches away from sealing a fluid in the interior of a microchannel and preventing a fluid from entering a fluid interface port. For example, the Howitz reference, in the sixth paragraph of the specification (column 1), specifies that "the length of each individual microcapillary is to be selected such that the target fluid will *spread up* to the capillary ends", with a "meniscus at the end of each microcapillary". In addition, the Howitz references relies on diffusion and/or convection mechanisms to mix a second liquid passing into the microcapillary

with a first liquid into the flow channel, which requires a sufficient amount of target fluid in the microcapillary. The Howitz reference therefore requires a substantial amount of dead volume in each microcapillary, precluding formation of a virtual wall with minimal dead volume, in contrast to the claimed invention.

The Columbus '313 reference and the Bjornson reference also do not disclose a fluid interface port that prevents liquid filling an associated microchannel from entering therein. Columbus '313 describes apertures having a relatively long length and size, requiring fluid from an associated channel to enter therein and resulting in a dead volume that is significantly **larger** than zero. For example, on page 9, lines 6-8, the Columbus '313 reference indicates that it is preferable for a liquid ingress aperture 27b in a flow control bridge to have a diameter of about 0.25 centimeters, which would result in a relatively large dead volume. In addition, the apertures 27 have a depth that is substantially *larger* than a diameter, resulting in a channel shape, in contrast to the claimed fluid interface ports, which have a disk shape.

In addition, the aperture 630 of Bjornson does not have a diameter that is substantially larger than a depth to create a disk-shaped aperture, as recited in independent claims 9 and 20. Moreover, in Bjornson, liquid in the reservoir 56 is forced *out* via the aperture 630 and into reservoir 142, in contrast to the claimed invention, which utilizes virtual wall fluid interface ports to inject fluid into a channel. The Bjornson reference does not disclose a fluid interface port in a side wall of a microchannel. Rather, the aperture 630 is formed in a reservoir 56 in Bjornson. There is no suggestion that the structure described in Bjornson would be suitable in a microchannel.

The Columbus '451 reference also does not disclose a fluid interface port in a microchannel filled with a fluid, where none of the fluid enters the fluid interface port. The liquid inlet aperture 46 in Columbus '451 also has a depth that is larger than the diameter, in contrast to the claimed invention. As specifically set forth in column 5, lines 29-34, the liquid inlet aperture 46 has a diameter of between about 1.0 mm and about 5.0 mm, preventing sealing of the fluid within an interior of an associated microchannel and resulting in a dead volume many times *larger* than one picoliter, and is incapable of forming a virtual wall, as required by the claimed invention.

Regarding the rejection of claims 42, 43, 44, 45, 61 and 62 over Sundberg in view of Bjornson and Howitz and, optionally, Swedberg, Figure 3 of Sundberg specifically illustrates ports 34 that are substantially filled with liquid 50, with the liquid held in the port 34 by capillary force, in clear contrast to the claimed invention, where no liquid enters into and is held by the port. Rather, the claimed fluid interface port seals the liquid inside the microchannel, *outside* of the fluid interface port, unlike the Sundberg reference.

None of the cited references disclose a fluid interface port capable of forming a virtual wall. The virtual wall forms a direct interface between the microchannel interior and the microchannel exterior, allowing direct access to the liquid in microchannel without introducing dead or unswept volume in the microchannel. Even if the devices in the cited references were capable of forming menisci, the menisci would not form virtual walls to allow a direct interface between the microchannel interior and the microchannel exterior, allowing direct access to the liquid in microchannel without introducing dead or unswept volume in the microchannel. In contrast, the channels in the Heller reference, the McCormick reference, the Amigo reference, the Howitz reference, the Columbus '313 reference, the Columbus '451 reference, the Bjornson reference, the Swedberg reference and the Sundberg reference do not directly interface a microchannel to the environment surrounding the device. These channels also do not form a direct interface, but rather a long, indirect opening with a large dead volume.

The particular dimensions of the claimed fluid interface port define a structure that allows the claimed device to perform in a particular manner not disclosed in the prior art. In fact, were the interfacing components in the cited references to have the claimed dimensions, the operation of the prior art devices would be significantly altered.

As described above, all pending claims distinguish patentably over the cited references taken either alone or in any combination. For at least these reasons, Applicants request that the rejections under 35 U.S.C. §103 be reconsidered and withdrawn. For at least the foregoing reasons, claims 1-14 and 16-45, 46-64 and 66-70 are patentable over the cited references and in condition for allowance.

CONCLUSION

In view of the above amendment, applicant believes the pending application is in condition for allowance. If a telephone conversation with Applicants' attorney would help expedite the prosecution of the above-identified application, the Examiner is urged to call the undersigned attorney at (617) 227-7400.

If any additional fee is due with this statement, please charge our Deposit Account No. 12-0080, under Order No. TGZ-001BRCE2, from which the undersigned is authorized to draw.

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Respectfully submitted,

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